DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

EE6702-PROTECTION AND SWITCHGEAR

UNIT-I

PART-A

1. Show the need for protective schemes in power system?
2. Name the types of fuses?
3. Summarize the role of protective relay in a modern power system
4. Define the term pick up value in a protective relay.
5. Define auto re-closing?
6. Summarize the functions of isolating switch?
7. Explain surge absorber? Differentiate it from surge diverter?
8. Identify the sources of fault power?
9. Identify the different types of faults occurring in power system?
10. Explain the importance of ground wire?
11. List the merits of resistance grounded system.
12. Analyze how arcing ground avoided can be avoided?
13. Differentiate between a short circuit and an overload?
14. What happen if earth wire is not provided in overhead transmission lines?
15. Classify the different types of earthing.
16. What is the necessity for earthing.
17. Generalize the duties of fault limiting reactor.
18. Define protection zone.
19. Classify the different types of zones of protection.
20. Show the examples for unit and non unit system of protection.

PART-B

1. (i)Summarize the importance of protective schemes employed in power system.(8)
   (ii)Show the essential quantities of protection.(8)

2. Discuss the symmetrical components method to analyze an unbalanced system.(16)

3. Discuss about three-phase symmetrical fault? Also discuss the different types of unsymmetrical faults that can occur on a three-phase system.(16)

4. Explain and draw the sequence network for the following type of faults:
   a. Single-line-to-ground fault
   b. Double- line-to-ground fault
   c. Line-to-line fault. (16)

5. In a 3-phase 4 wire system, the current R,Y and B under abnormal condition of loading are as under $I_R=100 \angle -30^o$ A, $I_Y=50 \angle 300^o$ A, $I_B= 30 \angle 180^o$ A. Calculate the positive, negative and zero-sequence currents in R line and return current in the neutral wire.(16)

6. (i)Explain different types of earthing the neutral point of the power system.(8)
   (ii)Formulate an expression for the reactance of the peterson coil in terms of capacitance of the protected line.(8)

7. Describe in detail about the Peterson coil? List the protective functions performed by this device.(16)

8. Discuss and compare the various methods of netural earthing(16)

9. (i)Explain the overlapping of protective zones with neat sketch.(9)

   (ii)Describe the different faults in power system. Which of these are more frequents?(7)

10. (i)Describe the fundamental requirements of protective relaying(6)

    (ii)Differentiate between surge diverter and surge absorber.Also explain the characteristics of an ideal surge diverter.(10)

11. (i)List the causes of over voltage?(4)
    (ii)Describe the protection scheme employed to protect from lighting and switching effects.(12)

12. (i)List the causes of short circuits due to failure of insulation on overhead conductors?(4) (ii)Briefly explain about resistance earthing and reactance earthing.(12)

13. (i) Define the terms pick-up value ,Plug setting multiplier and auto reclosure.(6)
    (ii) Discuss briefly the operation of
    (a) surge absorbers (b) surge diverters. (10)

14. (i)Draw and explain protective zone diagram for a sample power system netwoks.(8) (ii)A 3 phase 11 kV,25000 kVA alternator with X_{go} = 0.05 p.u., X_1= 0.15 p.u., X_2= 0.14 p.u., is grounded through a reactance of 0.3 ohm. Calculate the line current for a single line to ground fault.(8)

UNIT-II

PART-A

1. List the basic requirements of protective relay
2. Summarize the functions of protective relays.
3. Show the different types of electromagnetic relays?
4. Identify the applications of attracted armature type electromagnetic relay

5. Define time setting multiplier in protective relays.
6. Summarize the necessary conditions for two alternating fluxes acting on a common rotor
   (a) To produce same torque (b) to produce maximum torque.
7. Explain directional relay.
8. Discuss the effects of arc resistance?
9. Discuss R-X diagram?
10. A relay is connected to 400/5 ratio current transformer with current setting of 150%. Formulate the Plug Setting Multiplier when circuit carries a fault current of 4000A.
11. In what way a distance relay is superior to over current protection for protection of transmission line. Justify
12. List the different types of distance relay.
13. Show the merits of mho relay? And also draw its R-X diagram

14. Explain the principle of differential relay.
15. Define differential relay?
16. Discuss negative sequence relay? Where it is employed?
17. Explain under frequency relay?
18. Give the function of under frequency relay.
19. When is under frequency relay required in a power system?

Show which type of relay is best suited for long distance very high voltage transmission lines.

PART-B

1. Develop the different inverse time characteristics of over current relays and mention how the characteristics can be achieved in practice for an EM relay?(16)

2. Explain the general working of a relay and derive the fundamental torque equation.(16)

3. Discuss the construction details and principle of operation of induction type directional over current relay. (16)

4. Discuss the construction and principle of operation of non-directional induction-disc relay. (16)

5. Discuss the construction and operating principle of over current relay with directional scheme.(16)

6. Describe the operating principle, constructional features and area of applications of directional relay. How do you implement directional feature in the over current relay.(16)

7. (i)Explain the construction details and principle of operation of directional induction cup relay.(8)
8. (ii) Explain with the help of neat diagram the construction and working of induction type directional power relay.(8)

8. Show the MHO relay characteristic on the R-X diagram. Discuss the range setting of various distance relays placed on a particular location.(16)
9. Show in what way distance protection is superior to over current protection for the protection of transmission line.(16)

10. Explain the principle of working of distance relays. Describe with neat sketchs the following types of relays
    (i)Impedance relay
    (ii)Reactance relay
    (iii) Mho relay
    Indicate the difference on RX diagrams and show where each type is suitable. (16)

11. Describe the operating principles and characteristic of impedance , admittance and mho relays.(16)

12. Describe the principle of percentage biased differential relay with necessary diagrams. Also discuss its applications.(16)

13. Describe the principle of
    (i) Negative Sequence Relay(8)
    (ii) Under Frequency relay (8)

14. Explain the construction and working principle of negative sequence relay with a neat diagram.(16)

UNIT-III

PART-A

1. Can current transformers secondary winding be open circuited? Justify your answer.
2. List the application of current transformer.
3. Mention the difference between CTs used for protection and measurement.
4. Define the term burden on CT.
5. List the application of potential transformer.
6. Discuss the short comings of differential protection scheme as applied to power transformer .
7. Define the term pilot with reference to power line protection.
8. Show the applications of Buchholz's relay.
9. Identify the problems arising in differential protection in power transformer and how are they overcome?
10. Explain current grading of relays?
11. Explain over fluxing protection of a transformer?
12. List the common faults that occur in a generator
13. Discuss the most severe fault in the transmission line?
14. Discuss the type of relay is best suited for generation protection
15. Illustrate the different protection schemes used in bus-bars?
16. Explain the secondary of CT should not be open.
17. Discuss the type of relays are used to protect transmission line
18. Compose the common methods used for line protection?
19. Classify the various bus bar faults & Explain time-graded system protection?

PART-B

1. Compare CT & PT. What are the applications of CT & PT.(16)

2. Briefly discuss the protective devices used for the protection of large transformer.(16)

3. Classify different protection schemes normally used for protection of a power transformer from internal faults? Discuss one of them in brief.(16)

4. (i)Explain the Merz-price circulation current scheme of protection used for power transformer. (8) (ii)A three phase transformer of 220/11000 line volts is connected in star/delta. The protective transformers on 220V side have a current ratio of 600/5 . Calculate the current transformer ratio on 11000V side.(8)

5. A 3 phase transformer having line voltage ratio of 440 V / 11 kV is connected in star – delta. The protection transformer on the LV side has a ratio of 500 / 5. Estimate the ratio of the protection transformer connected on HV side?(16)

6. (i)Describe the differential protective scheme of transformer.(8)
7. (ii)Show the protective scheme employed for the bus bar.(8)
7. (i)Describe the construction and working of Buchholz relay.(8)(
   (ii) Explain the use of impedance relay on transmission line protection.

8. Discuss the principle of percentage biased differential protection with necessary diagrams. Also discuss its applications(16)

9. Describe the differential pilot wire method of protection of feeder(16)

10. A starr connected 3-phase,20MVA,11KV Alternator has a per phase reactance of 0.75 ohms/phase .It is protected by Merz price circulating current principle which is to operate for fault currents not less than 175A. Formulate the value of earthing resistance to be provided in order to ensure only 10% of the alternator winding remains unprotected. (16)

11. Describe the types of protective schemes employed for the protection of field winding and loss excitation of alternator.(16)

12. Describe the types of protective schemes employed for the protection of Busbar.(16)

13. Explain the types of protective schemes employed for the protection of Transmission line(16)

14. Show the different types of feeder and the protective schemes employed for the protection of feeder.(16)

UNIT-IV
PART-A

1. Discuss static relay?
2. Give the advantages of static relays?
3. Compose the problems arising in differential protection in power transformer and how are they overcome?
4. Show the Duality between Amplitude and Phase Comparators
5. Explain Comparator and its type.
6. Explain the function of Synthesis of Mho Relay Using Static Phase Comparator
7. Explain the function of Synthesis of Reactance Relay Using Cosine-type Phase Comparator
8. Explain the function of Synthesis of Simple Impedance Relay Using Amplitude Comparator
9. Define Amplitude Comparator and Phase Comparator
10. Distinguish the Synthesis of Various Distance Relays Using Static Comparators
11. Illustrate with neat Block diagram of Numerical relays
12. Define the Over Current Protection
13. Give the Different over current protection relays
14. Define the definite time over-current relay
15. Define the Inverse Time Over-current Relay
16. Define the Instantaneous OC Relay
17. Compose the advantages of over current relays over electromagnetic types?
18. Explain the Phase Comparators and write its type
19. Illustrate with neat Block diagram of Numerical Transformer Differential Protection
20. List the different methods of Numerical distant protection of transmission lines

PART-B

1. Define static relay? What are the merits and demerits of static relays over

electromagnetic relays also mention its applications. (16)

2. i) Define the Duality Between Amplitude and Phase Comparators.(8)
   ii) Define the type of Amplitude and Phase Comparators. (8)
3. Discuss the Synthesis of Various Distance Relays Using Static Comparators (16)
4. Explain with neat block diagram of the function of Synthesis of Mho Relay Using Static Phase Comparator (16)
5. Explain with neat block diagram of the function of Synthesis of Reactance Relay Using Cosine-type Phase Comparator (16)
6. distinguish briefly about the Phase Comparators and write its types (16)
7. Illustrate and Explain with neat Block diagram of Numerical relays (16)
8. Compose the problems arising in differential protection in power transformer and how are they overcome? (16)
9. Explain with neat block diagram of the function of Synthesis of Simple Impedance Relay Using Amplitude Comparator (16)
10. Assess the factors cause spill current on external fault in case of transformer Differential protection? (16)
11. Illustrate with neat Block diagram of Numerical Transformer Differential Protection (16)
12. Discuss with Neat Block diagram of different methods of Numerical Distance Protection of Transmission Line. (16)
13. Define the Over Current Protection and Explain its types briefly (16)

14. Define i) definite time over-current relay (8)
    ii) Inverse Time Over-current Relay (8)

UNIT-V

PART-A

1. List the methods of arc interruption.
2. Differentiate a.c. and d.c. circuit breaking
3. Discuss the arc phenomenon in a circuit breaker.
4. List the factors affecting the transient recovery voltage.
5. Define the term “rate of rise of recovery voltage”.
6. Explain recovery voltage?
7. Explain resistance switching?

8. Explain current chopping?
9. Define the importance of arc resistance? On which factor does it depend?

10. Discuss the different methods of arc extinction
11. Define restriking voltage
12. Assess the problems encountered in the interruption of capacitive currents

13. Explain the ratings of a circuit breaker?
14. Define the quenching factors in an Oil circuit breaker?
15. Show the making capacity of a circuit breaker?
16. Classify the circuit breakers?
17. Compose a suitable choice of circuit breakers for the following voltage ranges :(a) 3.3kV to 33kV, (b) 400kV to 760kV.
18. Give the advantage of SF6 circuit breaker over Air blast circuit breaker.

19. Compose Peterson coil? What protective functions are performed by this device?
20. Illustrate the disadvantages of an Air blast circuit breaker?

PART-B

1. Define the principle of arc extinction. What are the methods of arc extinction? Describe them in detail. (16)

2. i)Explain the arc interruption methods used in circuit breakers (8)
   ii)Explain Resistance switching for arc extinction in circuit breakers (8)
3. i) compose and Draw the schematic of a HVDC Circuit Breaker and explain its function (8)
   ii) Compose the problem of direct current interruption (8)

4. i) Explain how arc initiated and sustained when the circuit breaker contacts break (8)
   ii) Explain in detail the various methods of arc extinction in circuit breaker (8)

5. i) Show an expression for Restriking voltage and rate of rise of restriking voltage (RRRV) in a C.B. (8)
   ii) Illustrate the current chopping? Explain how can the effect of current chopping be minimized? (8)

6. i) Solve the RRRV of 132 kV circuit breaker with neutral earthed circuit breaker data as: broken current is symmetrical, restriking voltage has frequency of 20 kHz, and power factor is 0.15. Assume fault is also earthed. (8)
   (ii) Illustrate the selection of circuit breakers for different ranges of system voltages (8)

7 . i) Define resistance switching. (8)
   ii) Describe the operating principle of DC circuit breaker. (8)

8. Discuss with neat sketch, the construction and working of minimum oil circuit breaker. Also gives its merits and demerits. (16)
9. Describe the constructional details of SF6 circuit breaker and its operation. Give its advantages and disadvantages (16)

10. Discuss the different arc control mechanisms with suitable diagrams in bulk oil CB. (16)

11. Describe the principle constructional features of all types of air blast CB. Give its advantages and disadvantages. (16)

12. Describe the constructional details of vacuum CB and explain its principle of operation and working. (16)

13. Explain rupturing capacity, making capacity and short time rating and rated current of the circuit breaker. (16)

14. Compare the performance and characteristics of different types of CB.List out their merits and demerits (16)